The Potential for Eutrophication and Nuisance Algal Blooms in the Albemarle-Pamlico Estuary

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Summary

Phytoplankton primary production and its environmental regulation were examined at 3 stations representative of the lower Neuse River Estuary near the Pamlico Sound interface. This study covered a 3-year period (November 1987-October 1990). We also examined the roles of the major phytoplankton nutrients nitrogen and phosphorus in controlling growth and bloom formation. The overall potential for nuisance blooms and associated episodes of bottom water hypoxia and anoxia was investigated in field studies. The lower Neuse River estuary was well-mixed. Algal biomass and production varied seasonally, with high values in summer and low values in winter. In situ nutrient addition bioassays indicated the estuary experienced a general state of N limitation with especially profound limitation during summer periods. Bioassays during spring months showed increased algal biomass and production stimulation with the addition of N and P over that found with N addition alone.

While seasonal patterns predominated, the algal community responded during any season to increased flow and concomitant nutrient loadings by increasing biomass and production levels, often very rapidly. This was most dramatically demonstrated by a large Heterocapsa triquetra bloom during late winter of 1989-1990.

Dissolved inorganic nitrogen (DIN) levels were generally low, except during periods of high flow when heavy nutrient loading occurred. Dissolved inorganic phosphorus (DIP; as PO_4^{3-}] levels followed a seasonal pattern of high summer and fall values, and low winter and spring values. However, the highest [PO_4^{3-}] measured was during the winter 1989-90 loading event.

The Neuse River estuary can be classified as a mesotrophic system. Mean summer chlorophyll a concentrations were approximately 15-25 ug Chla/l. Annual primary production was 290-340 gC/m^2. While phytoplankton blooms did arise, no nuisance blooms were evident. However, potential nuisance taxa (cyanobacteria, dinoflagellates) were periodically present. No anoxic bottom waters were encountered during blooms, although some oxygen depletion was evident.

The zooplankton community maintained low species richness throughout the study. Abundance peaked in late summer, concurrent with late summer phytoplankton peaks. Zooplankton biomass did not seem to respond to winter or spring phytoplankton blooms.

Our recommendations for a management strategy include reductions in DIN, DIP, and suspended sediment loads in order to maintain the system in a nuisance bloom-free condition. In addition, nutrient-enriched precipitation (acid rain) will be of increasing importance as a source of nutrients (specifically nitrogen), in part because of increasing loads in the atmosphere but also because these nutrients are deposited directly into the lower estuary, bypassing the assimilative processes in the upper estuary. A future management strategy should incorporate both terrigenous and atmospheric nutrient loading when formulating input constraints.